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Enviro-Chem Superfund Site Supplemental Sampling Work Plan Revised

Prepared for

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USEPA

Prepared by

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Project Number TR0537

May 2019

Geosyntec
consultants

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1. INTRODUCTION

On behalf of the Trustee of the Environmental Conservation Chemical Site Trust Fund, Geosyntec Consultants (Geosyntec) with the assistance of Ramboll have prepared this Supplemental Sampling Work Plan for the Enviro-Chem Superfund Site (or Site) located at 985 S. US Highway 421 in Zionsville, Indiana (Figure 1). This work plan outlines the field activities required to close data gaps in the conceptual site model and further evaluate the groundwater flow and contaminant distribution along, and beyond the southern boundary of the Site.

1.1 Purpose

The purpose of the proposed work is to further evaluate the distribution of contaminants within the Upper Till and the Upper Sand and Gravel Unit along the southern boundary of the Site downgradient of Trench 6 between monitoring well S5, the southwest edge beyond monitoring well S6, and beyond the southern boundary of the Site (Figure 2). This work follows on from the additional supplemental investigation in the Upper Sand and Gravel unit conducted during the pumping test evaluation, sampling and monitoring conducted in 2017 (Geosyntec 2017). To the extent that there is limited off site migration in the Upper Sand and Gravel, this area is now well understood; however, additional investigations in this area are planned to complete the conceptual site model, as revised and submitted to the EPA on September 16, 2016 (Geosyntec, 2016), and provide additional information for the Remedial Alternatives Analysis and remedial design. Results from the proposed investigations in this work plan will inform recommendations for potential future remedial actions along the Site boundary near Trench 6. In addition, a contingency to collect information to support vapor intrusion (VI) modelling has been included in this work plan should the groundwater concentrations indicate that VI might be a potential concern.

1.2 Objectives

The specific objectives of the proposed work are to:

- Improve the understanding of the hydrogeology in the Upper Till and the Upper Sand and Gravel unit, near Trench 6;
- Determine the distribution of Site impacts in the Upper Till and Upper Sand and Gravel Unit along the southern boundary of the site;

- Determine the distribution of Site impacts in the Upper Till and Upper Sand and Gravel Unit beyond the southern boundary of the site;
- Install up to six new monitoring wells in the Upper Sand and Gravel Unit, along the southern boundary of the Site;
- Install up to three new monitoring wells in the Upper Till Unit, if any till water impacts are detected along the southern boundary of the site by the Waterloo^{APS} as described in section 3.1 below; and
- Following well installation, newly installed and existing wells along the southern boundary of the Site will be sampled for the compounds of concern (COCs) and geochemical parameters to provide additional groundwater data.

In addition, sampling will be conducted to aid in the EPA's evaluation of the potential vapor intrusion (VI) risks to the neighboring property, the Banker property at 1025 South US 421, Zionsville, Indiana. The data collected will provide input parameters for the EPA to conduct VI screening following the EPA's Office of Solid Waste and Emergency Response (OSWER) Vapor Intrusion Guidance (2015a) using the Vapor Intrusion Screening Level (VISL) Calculator (2015b):

- Install three soil vapor probes and, in addition to the collection of groundwater samples using the Waterloo^{APS}, collect soil samples from three locations between the Site and the Bankert property for analysis of soil gas permeability, bulk density, pore water saturation, and total soil porosity to aid in evaluation of the potential for VI risks. The model is often run using estimates based on lithology but these samples will provide site-specific measured data; and
- Collect screening level information of the construction of the house on the Bankert property for evaluation of the potential for VI risks.

1.3 Organization

This Work Plan is organized as follows:

1. Section 2 presents a summary of the Site background;
2. Section 3 describes the proposed investigation and sampling;
3. Section 4 presents the project schedule; and

4. Section 5 contains a list of all references.

2. BACKGROUND

2.1 Geology

The Site is underlain by five stratigraphic units, which are present in the following descending order (from shallowest to deepest):

(1) Superficial Fill of gravel and sand with well-graded and non-native sand (select areas of the site, near trenches and support zone in the south; Figure 1);

(2) Upper Till composed predominantly of clayey silt and silty clay with occasional lenses of sand and gravel;

(3) Upper Sand and Gravel, a fine to coarse sand and gravel unit with some silt lenses;

(4) Lower Till, an aquitard composed predominantly of clayey silt and silty clay; and

(5) Lower Sand and Gravel of dense sand lenses and finer grained glacial tills.

This supplemental investigation focuses on the Upper Till and Upper Sand and Gravel stratigraphic units.

2.2 Hydrogeology

Historical water level measurements indicate that groundwater in the Upper Sand and Gravel Unit generally flows southward with a slight south east component towards the southeast end of the Site. The potentiometric water elevation contours presented in the June 2016 Surface and Subsurface Water Sampling Report, Revision 1 (Ramboll, 2017) are shown in Figure 2.

2.3 Contaminant Distribution

Pumping tests performed in the off-site area, immediately south of Trench 6, indicate that groundwater flows beneath the TBCW near piezometer PS-3 and upwells on the downgradient side within a thick sequence of coarse-grained deposits in the Upper Sand and Gravel Unit (Figure 2; Geosyntec 2017). The pumping test results indicate that PS-3 and other piezometers located in the proximal off-site area are well connected.

Monitoring well MW-14 is a distal location that appears to be more weakly connected to PS-3 and is associated with a thinner and more fine-grained Upper Sand and Gravel Unit.

Flow beneath the TBCW at PS-3 appears to be a focal point for plume migration off-Site. Groundwater in the Upper Sand and Gravel unit is inferred to flow from the upwelling zone, towards the south (MW-14) and southeast (S-5).

Groundwater analytical data from the Upper Sand and Gravel unit indicates a plume of volatile organic compounds (VOCs) comprising 1,2-DCE, VC and 1,1,1-TCA that has migrated beneath the TBCW at the southern end of the ECC Site. The 1,2-DCE and VC plume in that unit is inferred to migrate from the upwelling zone, whereas the 1,1,1-TCA portion of the plume appears to be more localized (PZT-4) and appears to be associated with flow under the TBCW. The field and analytical data are encouraging for natural attenuation of chlorinated solvents. Only 1,2-DCE exceeds the ASC of 320 μg/L in PS-3, PZT-1 and PZT-3. Attachment 1 provides supporting information.

3. SCOPE OF WORK

The investigation activities presented in this work plan include both adaptive field investigation activities using a direct push technology (DPT) drill rig and an onsite mobile laboratory as well as installation and sampling of permanent monitoring wells. The field investigation activities will be performed primarily by Ramboll with support and data interpretation from Geosyntec. Prior to the start of drilling activities underground utilities and/or installations will be marked. The exact location of the proposed DPT borings and groundwater grab sample depths and subsequent wells presented in this work plan may be adjusted slightly based on access, subsurface or overhead obstructions and restrictions (e.g. above or below ground utilities), and real-time evaluation of data from the DPT sampling tool.

The subsequent subsections provide a description of the scope of work recommended by Geosyntec.

3.1 Groundwater Sampling and Hydraulic Analysis Using Direct Push Sampling Equipment

Groundwater samples will be collected from the Upper Till and Upper Sand and Gravel units using DPT equipped with a groundwater profiling tool (Waterloo Advanced

Profiling System, a.k.a. the Waterloo^{APS}). The Waterloo^{APS} is a direct push groundwater sampling tool owned by Cascade (previously owned by Stone Environmental) that is a proprietary modification of the Waterloo Profiling tool. In addition to the collection of groundwater samples for chemical analysis, the Waterloo^{APS} has custom software that provides real-time visual display of the Index of Hydraulic Conductivity (IK) recorded versus depth to infer site stratigraphy and locate optimal sampling intervals. This software also displays hydraulic head at each sample depth, and the depth and rate of penetration while advancing the tooling. Additional information regarding the Waterloo^{APS} is included in Attachment 2.

A series of 13 borings will be advanced with the Waterloo^{APS} along the southern boundary of the Site in a transect perpendicular to groundwater flow (Figure 3). Ten of the borings will extend from ground surface to the top of the Lower Till and will collect groundwater samples from the first water strike in the till and thereafter approximately every 5 ft with depth. An additional three borings will extend only through the Upper Till and will be paired with existing Upper Sand and Gravel wells (PZT-2, S-7 and PZT-4). These three borings will collect approximately three groundwater samples per location through the Upper Till. An additional seven borings will be advanced downgradient of the southern boundar of the Site in a transect perpendicular to groundwater flow (Figure 4). To ensure groundwater samples are collected from a discreet interval, samples will be collected starting at the shallowest depth interval and proceeding with depth.

Groundwater samples collected from each location will be analyzed immediately by a NELAP-accredited on-site laboratory for VOCs. Boring locations may be altered slightly from those shown on Figures 3 and 4, or new locations may be added, based on the results from the first and subsequent borings.

Once the target depth interval is reached, a groundwater sample will be collected into laboratory provided bottles using a positive displacement nitrogen gas-drive pump. Prior to sample collection for VOCs analysis, physiochemical parameters including pH, specific conductance (SC), dissolved oxygen (DO), and oxidation/reduction potential (ORP) will be measured and recorded. All samples will be analyzed by a National Environmental Laboratory Accreditation Program (NELAP)-accredited onsite laboratory using Solid Phase Micro Extraction (SPME), a NELAP accredited sample preparation technique.

Depending on availability, two Waterloo^{APS} systems may be employed in order to maximize sample collection rates and minimize potential for on-site lab downtime. While one is purging and sampling, the second will be advanced by the direct push drill rig. The drill rig will move from one Waterloo^{APS} to the other so that one is being advanced, and the other is sampling at all times.

3.2 Monitoring Well Installation

3.2.1 Upper Sand and Gravel Unit Wells

A hollow-stem auger will be used to install five permanent groundwater monitoring wells at the locations identified in Figures 3 and 4. Depending on the results of the Waterloo^{APS} sampling an optional sixth monitoring well will be installed west of S6. This sixth monitoring well will be installed if the groundwater samples from beneath the screen interval at S6 or the Waterloo^{APS} boring location from the furthest westward location, indicate VOC impacts in this area in the Upper Sand and Gravel. The final location of this sixth monitoring location, as well as the location of all the other monitoring wells, will be refined using the data from the Waterloo^{APS} sampling.

The results of the hydraulic profiling from the Waterloo^{APS} will be used for identifying the Upper Till, Upper Sand and Gravel, and Lower Till units. The proposed soil boring will extend from ground surface to a maximum of 5 feet into the Lower Till (approximately 30-35 feet from ground surface at the western edge of the transect and 20-25 ft bgs at the eastern edge near S-5). The borehole will be backfilled with grout to the base of Upper Sand and Gravel Unit in preparation for the well installation.

The well screen will be 10 feet in length and will be screened within the Upper Sand and Gravel Unit. If the thickness of the Upper Sand and Gravel Unit is less than 10 feet at that location, the well screen will span the thickness of the Upper Sand and Gravel Unit. The monitoring well will be constructed of 2-inch diameter PVC well casing with a 0.010 PVC screen. The well will be installed with a sand pack consisting of 10 to 20-mesh sand. If the Upper Sand and Gravel Unit is greater than 10 ft thick, the vertical depth interval of the well screen will be determined based on the concentration profile shown by the Waterloo APS system groundwater sampling results.

3.2.2 Upper Till Monitoring Wells

A hollow-stem auger will be used to install up to three permanent groundwater monitoring wells in the Upper Till unit only if the results of the Waterloo^{APS} sampling indicate an area of impacted groundwater (i.e. containing VOCs above the groundwater quality criteria) in this depth interval. The final location of these potential Upper Till monitoring locations will be refined using the data from the Waterloo^{APS} sampling.

The results of the hydraulic profiling from the Waterloo^{APS} will be used for identifying the Upper Till, Upper Sand and Gravel, and Lower Till units. The proposed soil boring will extend from ground surface to a maximum of 2 feet into the Upper Sand and Gravel Unit (approximately 20 feet from ground surface at the western edge of the transect and 15 ft bgs at the eastern edge near S-5). The borehole will be backfilled with grout to the base of Upper Till unit in preparation for the well installation.

The well screen will be 10 feet in length and will be screened within the Upper Till Unit. If the thickness of the Upper Till Unit is less than 10 feet at that location, the well screen will be shortened and the screen will span the thickness of the Upper Till Unit. The monitoring well will be constructed of 2-inch diameter PVC well casing with a 0.010 PVC screen. The well will be installed with a sand pack consisting of 10 to 20-mesh sand. If the Upper Till Unit is greater than 10 ft thick, the vertical depth interval of the well screen will be determined based on the concentration profile shown by the Waterloo APS system groundwater sampling results.

3.2.3 Well Development and Surveying

The monitoring wells will be developed and allowed to recover for a minimum period of 24 hours prior to sampling.

The Waterloo^{APS} locations, the new permanent monitoring wells, and the top of casing at existing wells and piezometers in the southern area at the site will be surveyed by a licensed surveyor.

3.3 Monitoring Well Sampling

Following the installation of the new monitoring wells, all newly installed wells and existing wells (S5, S6, S7, PZT-1, PZT-2, PZT-3, PZT-4, MW-14) will have a round of manual water elevations measurement and will be sampled using low-flow methods to monitor COC concentrations and groundwater flow patterns.

Monitoring well sample locations are identified on Figures 3 and 4. Low flow sampling will be conducted in accordance with USEPA-approved low-flow sampling methods, the Quality Assurance Project Plan (QAPP) and subsequent QAPP Amendments. Samples will be analyzed for VOCs and 1,4 Dioxane by Pace Analytical of Indianapolis, Indiana using USEPA SW-846 Method 8260B and EPA Method 8260 SIM or 8270 SIM, respectively.

3.4 Vapor Intrusion Evaluation

In order to evaluate the potential risk of VI at the neighboring property, soil samples and field screening level evaluations will be conducted as part of this field effort. Soil samples will be collected at three locations between the Site and the Bankert house at locations identified on Figure 4. Soil samples will be collected using either a direct push core or Shelby tube to collect soil from approximately 3 to 5 ft bgs for analysis of bulk density, pore water saturation, and total soil porosity. The soil type will be logged as part of the sampling effort. Soil gas probes will be installed in the borings between approximately 3 and 4 ft bgs and will be tested for soil gas intrinsic permeability. Attachment 3 includes the procedures for installation of the soil gas probes and the soil gas permeability testing. All of this information will be provided to the EPA to include as inputs to the VI screening to further evaluate the potential risks of VI.

In addition, general information on the construction of the Bankert house will also be collected during this field event such as presence of a basement, construction methods (e.g., slab on grade, concrete block or poured concrete foundation, etc) to provide additional information on evaluation of the potential risk of VI.

4. SCHEDULE

An anticipated schedule to complete the field investigation activities discussed in this work plan is presented below:

Task	**Timeframe**
Approval to proceed received from the EPA.	Week 0
Field preparation including scheduling, subcontractor contracting and Site access	6 weeks
Completion of Waterloo^{APS} profiling and monitoring well installation, and sampling.	3 weeks - weather dependent
Compilation of field data report completed by Ramboll.	4 weeks
Analysis and generation of a report by Geosyntec that summarizes the finding of the results.	5 weeks
Total Number of Weeks to Completion Following Approval to Proceed	**18 weeks**

5. REFERENCES

Geosyntec. (2016). *Enviro-Chem (ECC) Superfund Site Conceptual Site Model Revision 1*. Guelph Ontario: September 16, 2016: Geosyntec Consultants, Inc.

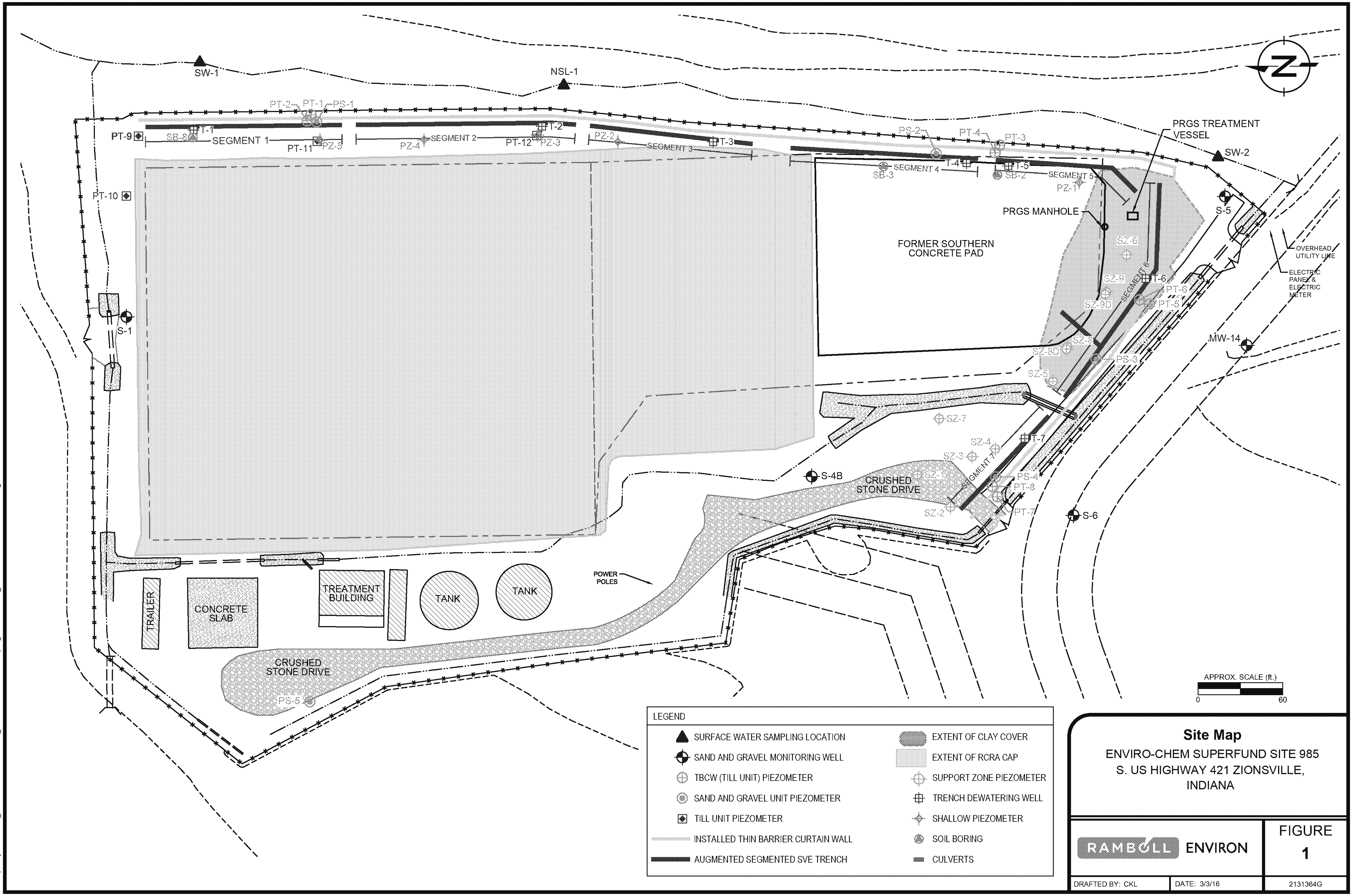
Geosyntec. (2017). Enviro-Chem (ECC) *Superfund Site Conceptual Site Pumping Test*. Guelph Ontario: December 7, 2017: Geosyntec Consultants, Inc..

Ramboll. (2017). June 2016 Surface and Subsurface Water Sampling, Revision 1, Enviro-Chem Superfund Site, Zionsville, Indiana. February 15, 2017: Ramboll Environ US Corporation.

Environmental Protection Agency (EPA). 2015a. OSWER Technical Guide For Assessing And Mitigating The Vapor Intrusion Pathway From Subsurface Vapor Sources To Indoor Air.

Environmental Protection Agency (EPA). 2015b. Vapor Instrusion Screening Level (VISL) Calculator, User's Guide. Currently available online at: http://www.epa.gov/oswer/vaporintrusion/guidance.html

FIGURES



Site Map

ENVIRO-CHEM SUPERFUND SITE 985
S. US HIGHWAY 421 ZIONSVILLE,
INDIANA

RAMBOLL ENVIRON

FIGURE
1

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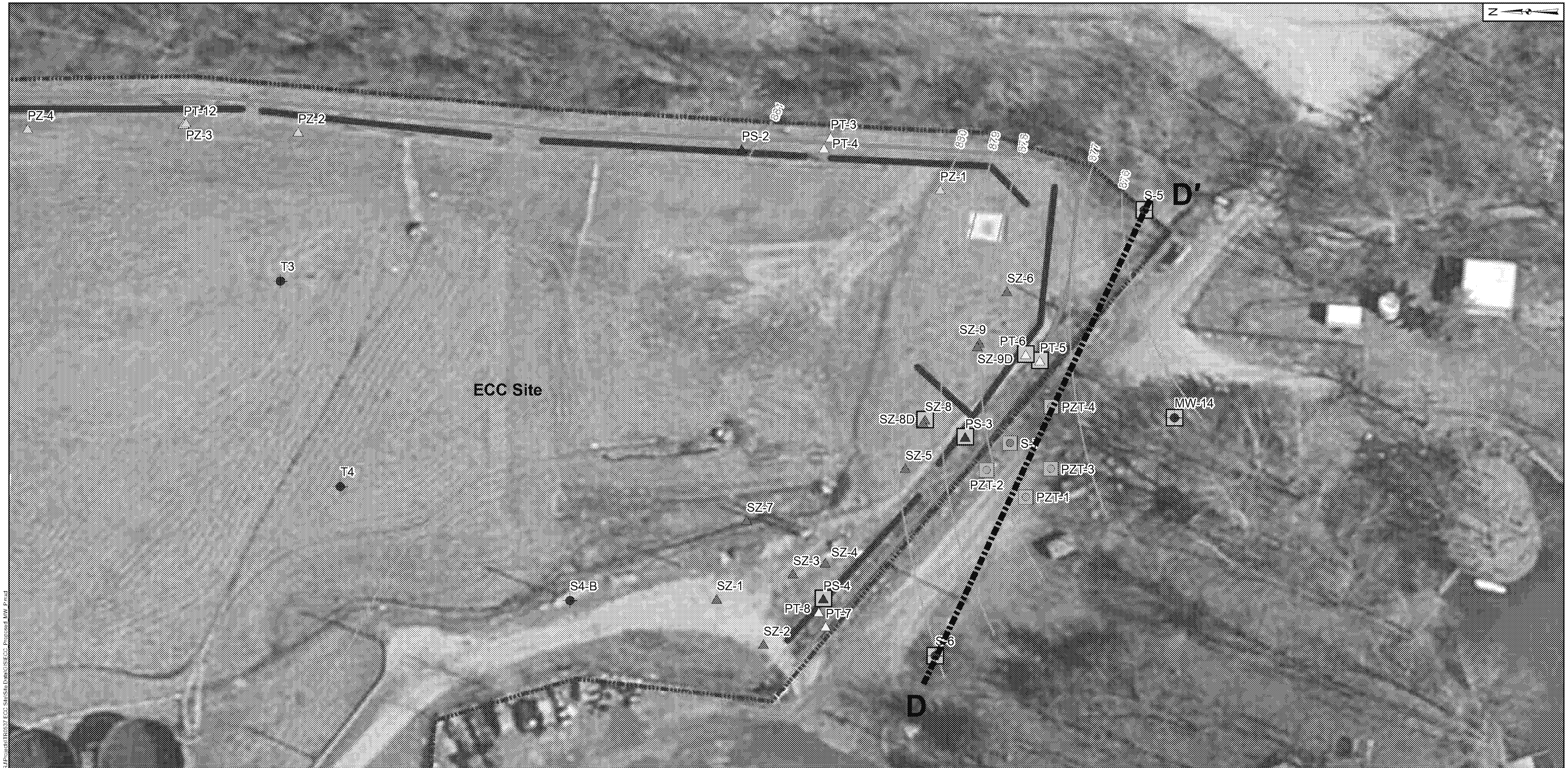

Legend

- Proposed Permanent Monitoring Well
- Proposed Piezometer
- Upper Sand and Gravel Monitoring Well
- Support Zone Piezometer
- Upper Till Piezometer (TBCW)
- Upper Sand and Gravel Piezometer
- Shallow Piezometer
- Proposed Boring
- Additional Proposed Monitoring Locations
- Cross-Section
- Groundwater Contours - Upper Sand & Gravel Unit (Ramboll, 2016)
- Thin Barrier Curtain Wall
- Augmented Segmented SVE Trench
- Site Boundary

Notes:

TBCW - Thin Barrier Curtain Wall

1. Ramboll. (2016). June 2016 Surface and Subsurface Water Sampling, Enviro-Chem Superfund Site, Zionsville, Indiana. September 26, 2016: Ramboll Environ US Corporation.
2. Basemap Source: ESRI, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo.

50 25 0 50 Feet

Groundwater Flow Regime Upper Sand and Gravel Unit (June 2016)
Enviro-Chem Superfund Site
985 South U.S. Highway 421, Zionsville, Indiana

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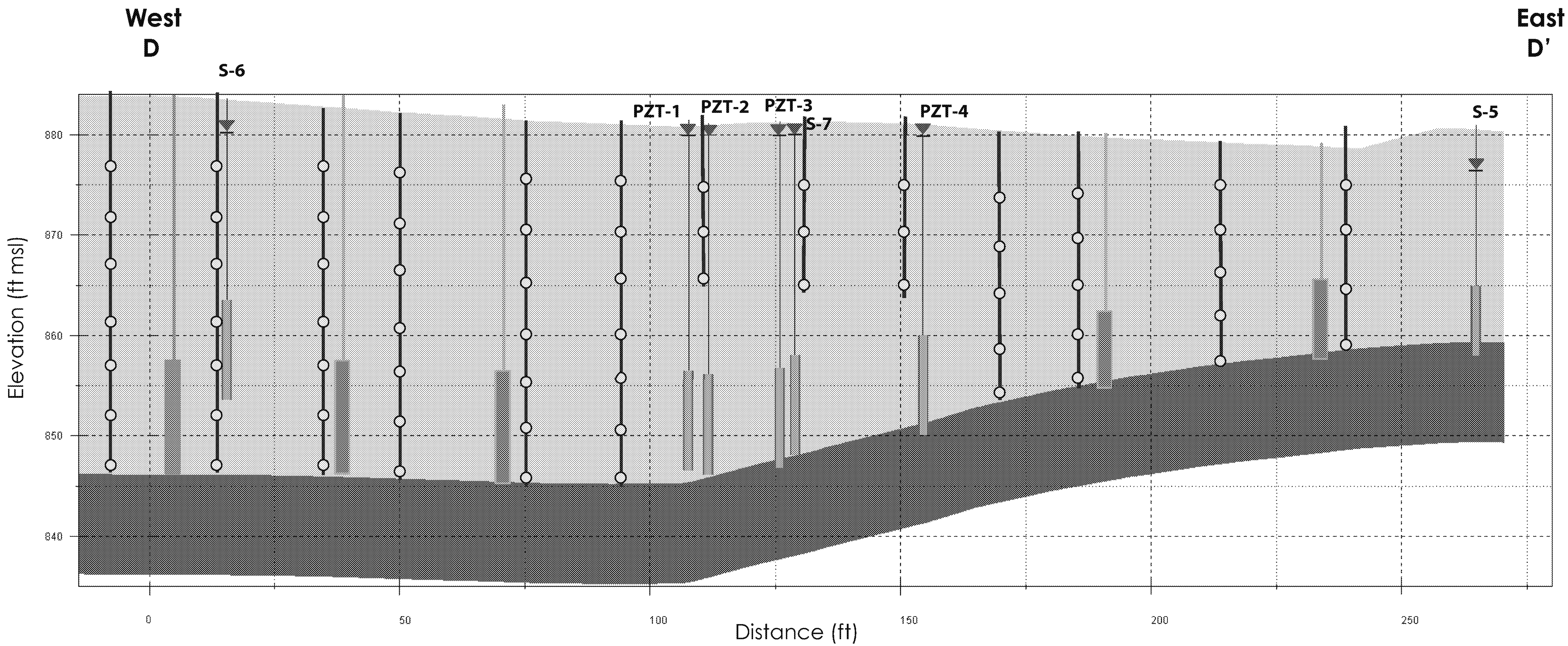
Figure 2

Coordinate System: NAD 1927 StatePlane Indiana West FIPS 1302



Legend

- Groundwater Sampling Location
- Water Elevation
- Location of Waterloo^APS profiles
- Well Screen Interval
- Proposed Monitoring Well
- Optional Monitoring Well

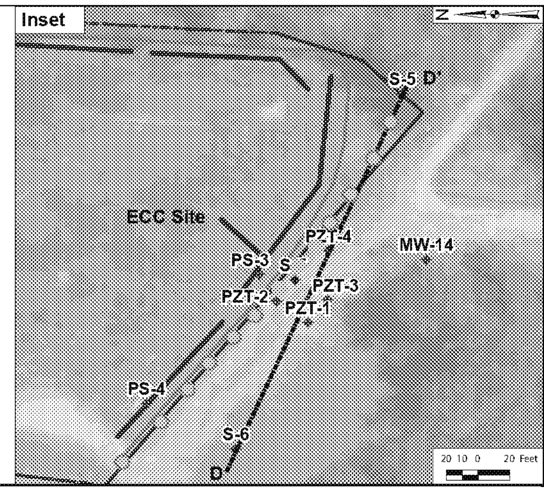
Geology

- Upper Till
- Upper Sand and Gravel
- Lower Till

Notes:
ft-feet
ftmsl–feet mean sea level

Inset Legend

- DPT Sampling Location – Upper Till
- DPT Sampling Location – Upper Till and Upper Sand and Gravel
- Upper Sand and Gravel Monitoring Well
- S-7 (Pumping Well)
- Cross-Section
- Thin Barrier Curtain Wall
- Augmented Segmented SVE Trench
- Site Boundary



Groundwater Flow Regime (East-West Section)
Enviro-Chem Superfund Site
985 South U.S. Highway 421, Zionsville, Indiana

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Figure 3

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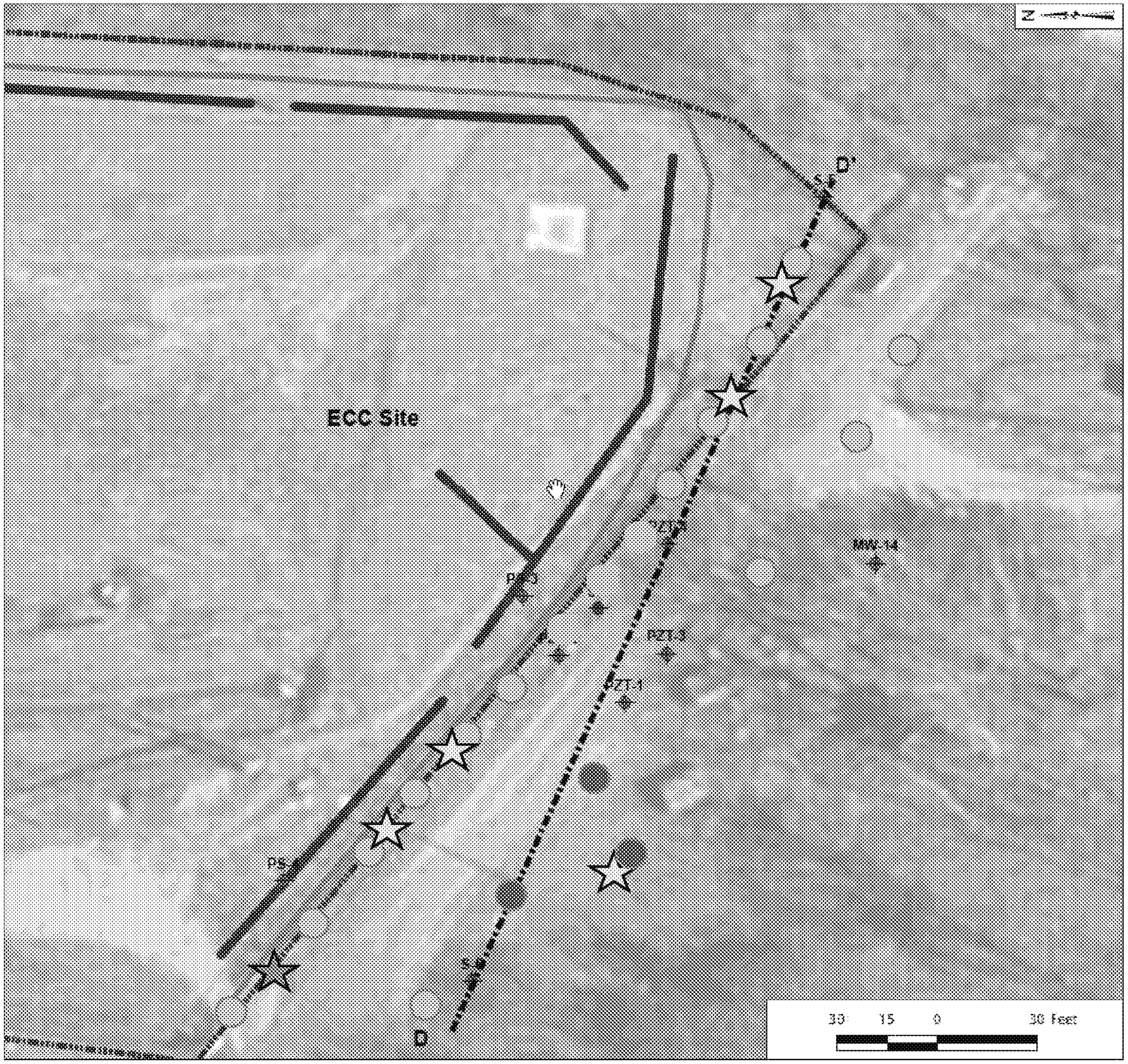

- DPT Sampling Location – Upper Till
- DPT Sampling Location – Upper Till and Upper Sand and Gravel
- DPT Sampling Location – Upper Till and Upper Sand and Gravel; installation of soil gas probe and collection of soil samples for VI screening
- Proposed Monitoring Well
- Optional Monitoring Well

Proposed Sampling Plan South of Property Boundary
Enviro-Chem Superfund Site
985 South U.S. Highway 421
Zionsville, Indiana

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Figure 4

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internal info: path, date revised, author

ATTACHMENT 1: SUPPORTING FILES

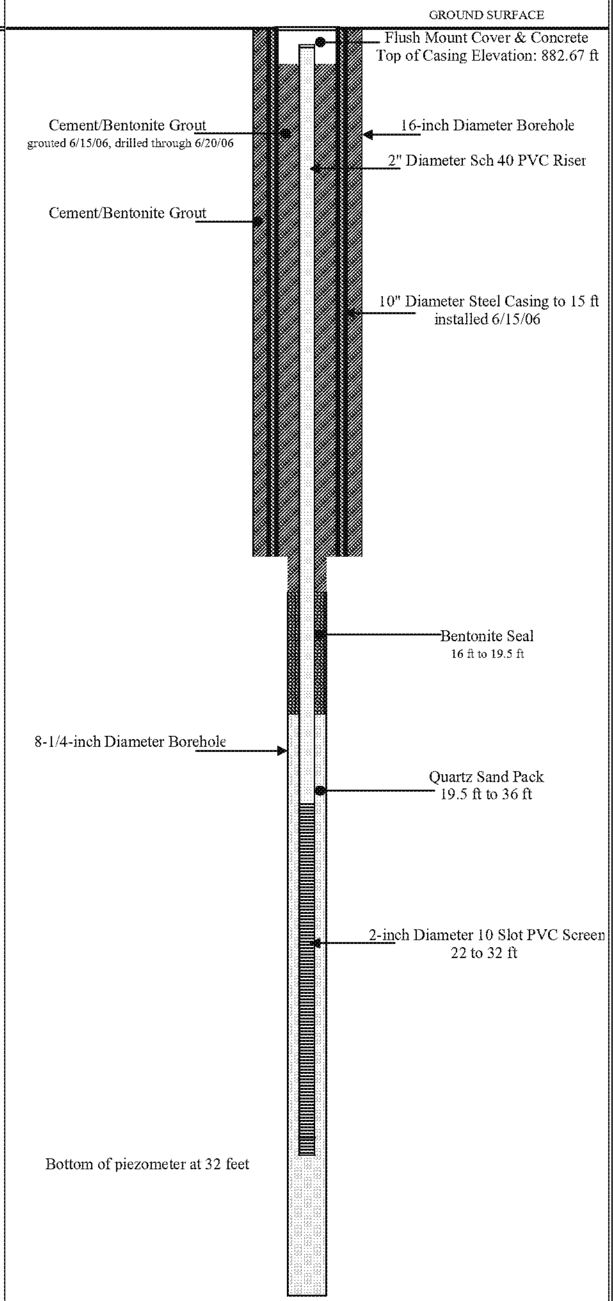
ENVIRON

WELL LOG

PROJECT NAME:	**ECC TBCW Piezometers**	**WELL NUMBER:**	**PS-3**
PROJECT NUMBER:	21-6585M	**DRILLING DATE:**	6/15/06 and 6/20/06
PROJECT LOCATION:	Enviro-Chem Site, Zionsville, IN	**FIELD PERSON:**	Doug Burge, P.G.
DRILLING CONTRACTOR:	Earth Exploration, Inc	**TOTAL WELL DEPTH:**	32 feet
RIG TYPE:	D-120 ATV	**WELL DIAMETER / MATERIAL:**	2-inch diameter Schedule 40 PVC

LITHOLOGY DESCRIPTION	DESCRIPTION INTERVAL (ft)	PID (ppm)	Blow Counts (per 6")	Recovery	GRAPHIC LITHOLOGY	DEPTH (ft bgs)
Gravel fill						1--
Silty clay, trace pebbles, roots, brownish gray to medium gray, stiff, moist; with sand seam at 7.8 feet.	2-8	0	5/3/5/5	0.6		3--
		0	4/4/4/4	2		5 --
		0	4/3/3/4	2		7--
Silty clay, some fine sand, olive to med gray, soft.	8-10	0	2/2/2/2	1.8		9--
Silty clay till, trace to some sand, medium gray, cohesive, wet; with sand seams at 10.7- and 12.6-foot depths.	10-17	0	2/2/4/4	0.9		11--
		0	9/7/9/5	1.4		13--
		0	5/6/6/8	1.5		15--
		0	2/2/3/2	1.3		17--
Very coarse sand, with silty clay, medium gray, loose, wet.	17-19.5	0	2/2/3/4	1.8		19--
Medium to coarse sand and small gravel, medium gray, loose, wet. (Sand heave and thin seam of silty clay noted around 20 feet).	19.5-32.5	0	8/8/9/10	1.3		21--
		0	10/12/15/16	1.8		23--
		0	15/15/13/10	1.4		25--
		0	16/13/11/12	1.5		27--
		0	9/9/8/10	1.3		29--
		0	8/8/6/7	1.5		31--
Fine sand, medium gray, loose, wet.	32.5-35	0	22/12/13/20	1.5		33--
		0	8/8/7/9	1.2		35--
Silt, little to some clay, trace pebbles, medium gray, plastic, wet.	35-38	0	5/6/7/9	1.4		37--

WELL CONSTRUCTION DETAIL



Note: PS-3 piezometer installed approximately 60 feet northwest of boring PS-3-O (original location).

CH2M HILL

PROJECT NUMBER	BORING NUMBER
W64641.FQ	ECC SB-07 SHEET 1 OF 2

SOIL BORING LOG

PROJECT NSL/ECC LOCATION Zionsville, Indiana
ELEVATION DRILLING CONTRACTOR ATEC Associates
DRILLING METHOD AND EQUIPMENT 3 3/8" HSA Mobile Drill B61
WATER LEVEL AND DATE START 4/11/88 FINISH 4/12/88 LOGGER B. Brownfield

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		S1	2.0	23-25-35-35 (60)	Crushed limestone fill, stained black for top foot.		HNu-10ppm
		S2	2.0	24-20-8-8 (28)	8" Crushed limestone fill 16" silt, dark brown, ~10% fine sand, moist low plasticity (ML)		HNu-11ppm
5		S3	0.5	6-8-10-10 (18)	Rubbish - silicon sealant, rocks (fill)		HNu-2ppm
		S4	1.3	9-4-4-4 (8)	8" rubbish as above 8" Silt w sand & clay - dark brown, moist, soft low plastic, ~20% fine sand (ML)		HNu-4ppm
		S5	1.0	2-2-3-4 (5)	as above, more wet		HNu-Bkg
10		S6	1.5	2-2-4-7 (6)	12" as above 6" sand, fine, gray, wet ~10% silt (SP-SM)		HNu-Bkg
		S7	0.7	0-0-2-3 (2)	6" sand as above 2" gravel (1/2" max) well graded, wet		HNu-Bkg
15		S8	2.0	6-8-9-12 (17)	Sand med coarse, gray, wet, well graded, small gravel (~10%) V. clean (SW)		HNu-Bkg HNu Bkg
		S9	1.5	6-8-12-12 (20)	Same as above		
		S10	1.3	8-8-10-11 (18)	Same as above		
20		S11	1.3	10-13-13-14 (26)	Same as above		
		S12	1.7	11-13-18-24 (31)	Same as above, medium (~5%gravel) lack of fine sand (SP)		
25		S13	1.8	30-23-27-60 (50)	8" same as above 14" silt, gray, moist, nonplastic, ~20% fine, fine sand seams every 2-3" (ML)		0820 Rocks @ interface of sand and silt. bottom 1" of spoon was hard dry fill
		S14	1.5	38-80-100/6"	Silt, gray, dry on inside, wet on outside Small rock fragments (>5%), hard.		Took Chemical Sample out of S13
		S15	1.8	25-31-55-65 (86)	7" Same as S14 7" sand, med, gray, wet, poorly graded, clean (SP) 8" Same as S14 (ML)		Till

Rev 8/15/88

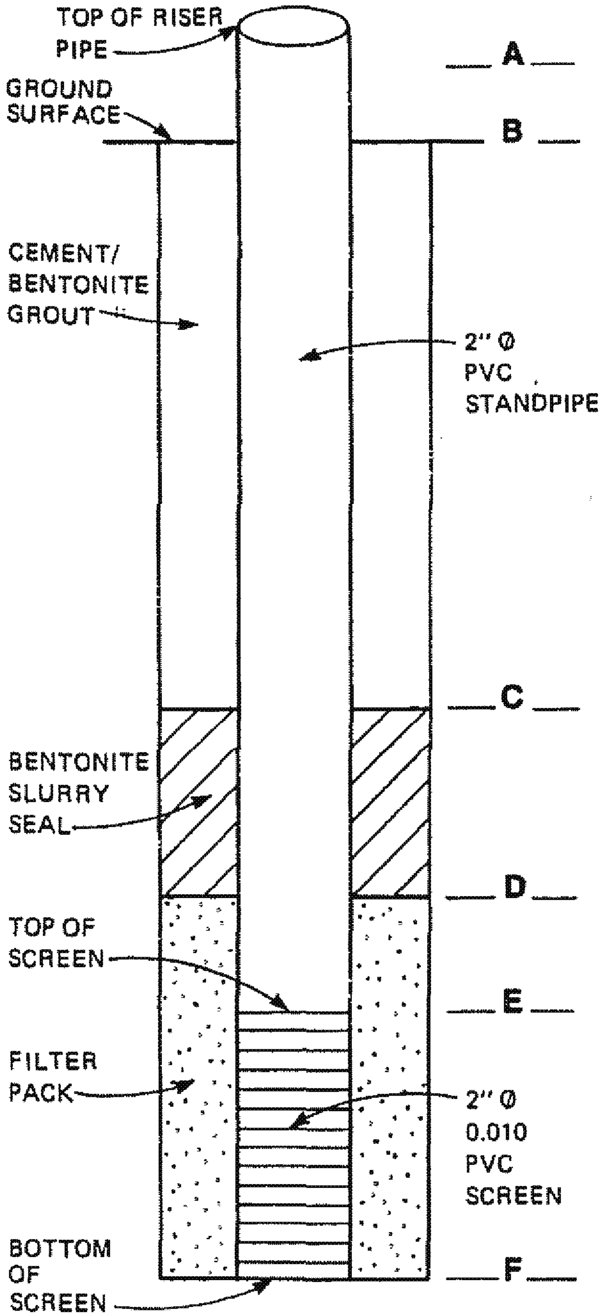
CH2M HILL

PROJECT NUMBER	BORING NUMBER
W64641.FQ	ECC SB-07 SHEET 2 OF 2

SOIL BORING LOG

PROJECT NSL/ECC LOCATION Zionsville, Indiana
ELEVATION DRILLING CONTRACTOR ATEC Associates
DRILLING METHOD AND EQUIPMENT 3 3/8" HSA Mobile Drill B61
WATER LEVEL AND DATE START 4/11/88 FINISH 4/12/88 LOGGER B. Brownfield

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30		S16	2.0	25-40-55-75 (95)	Same as S14		HNu Bkg
					End Soil Boring @ 32'		
35							



	NSLSBP100	NSLSBP102	NSLSBP104	NSLSBP108	NSLSBP111	NSLSBP117
A	923.4	932.1	918.2	932.4	923.6	886.6
B	921.3	930.3	915.9	929.3	921.6	886.0
C	900.8	920.3	904.9	908.3	907.1	847
D	897.8	917.3	902.9	906.3	905.1	845
E	894.3	915.3	898.9	904.3	903.1	844
F	884.3	905.3	888.9	894.3	893.1	842

	NSLSBP118	NSLSBP119	NSLSBP122	NSLSBP124	ECCMW12	ECCMW13
A	882.8	882.7	877.9	880.3	885.5	883.3
B	880.8	879.7	876.2	878.7	883.3	880.2
C	866.8	865.7	870.2	872.7	882.3	878.2
D	864.8	863.7	868.2	870.7	881.3	877.2
E	863.8	862.7	866.1	868.7	873.3	876.2
F	858.8	857.7	861.1	863.7	868.3	866.2

	ECCMW14[a]	ECCMW15	ECCMW16	ECCMW17	ECCMW18	ECCMW19A
A	880.9	880.3	881.0	883.0	879.9	879.9
B	878.7	878.8	878.6	880.8	877.2	877.7
C	868.7	868.8	873.6	873.8	866.5	873.7
D	866.7	866.8	871.6	871.8	864.5	871.8
E	863.7	864.8	869.6	869.8	862.2	871.1
F	853.7	859.8	864.6	864.8	857.2	867.6

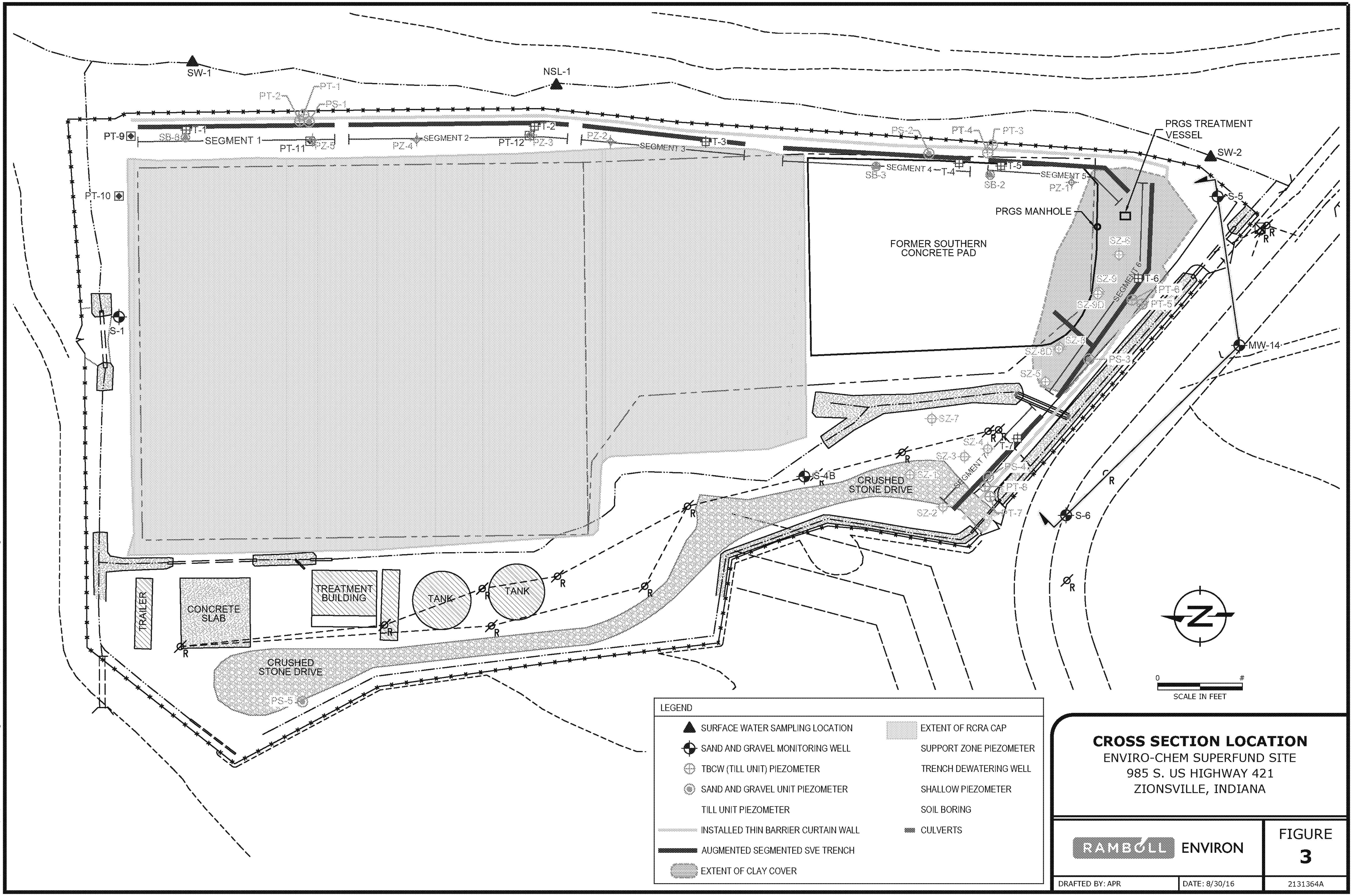
	ECCMW19B	ECCMW20	ECCMW21	ECCMW22[a]	ECCMW23	PUMP TEST WELL[a, b]
A	880.3	876.5	882.6	875.7	(Surface elevation not available)	878.4
B	877.6	874.1	879.8	873.4		875.6
C	863.1	865.1	865.8	858.4		866.6
D	861.1	863.1	863.6	856.4		864.6
E	858.4	861.1	862.8	853.4		862.6
F	848.4	846.1	847.8	843.4		852.6

Notes:

[a] Elevation estimated using nearby soil boring elevation.

[b] Pump test well was constructed of 4" diameter PVC rather than 2".

FIGURE 6
MONITORING AND OBSERVATION WELL CONSTRUCTION DIAGRAM
NSL/ECC TECH MEMO



LEGEND

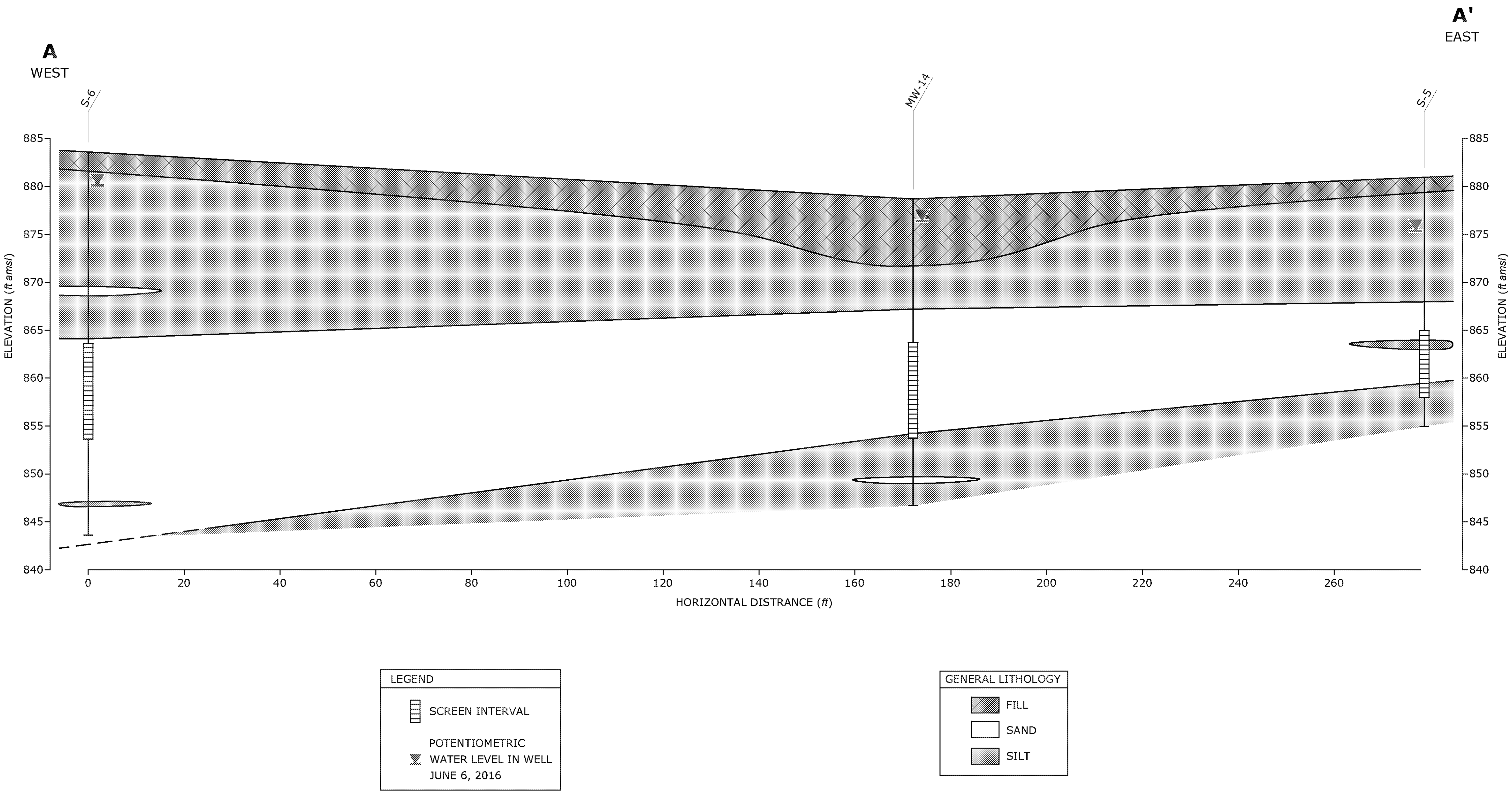
- SURFACE WATER SAMPLING LOCATION
- SAND AND GRAVEL MONITORING WELL
- TBCW (TILL UNIT) PIEZOMETER
- SAND AND GRAVEL UNIT PIEZOMETER
- TILL UNIT PIEZOMETER
- INSTALLED THIN BARRIER CURTAIN WALL
- AUGMENTED SEGMENTED SVE TRENCH
- EXTENT OF CLAY COVER
- EXTENT OF RCRA CAP
- SUPPORT ZONE PIEZOMETER
- TRENCH DEWATERING WELL
- SHALLOW PIEZOMETER
- SOIL BORING
- CULVERTS

CROSS SECTION LOCATION
ENVIRO-CHEM SUPERFUND SITE
985 S. US HIGHWAY 421
ZIONSVILLE, INDIANA

RAMBOLL ENVIRON

FIGURE
3

DRAFTED BY: APR | DATE: 8/30/16 | 2131364A



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RAMBOLL ENVIRON

DRAFTED BY: APR | DATE: 9/7/16

CROSS SECTION A-A'
ENVIRO-CHEM SUPERFUND SITE
985 S. US HIGHWAY 421
ZIONSVILLE, INDIANA

FIGURE
4

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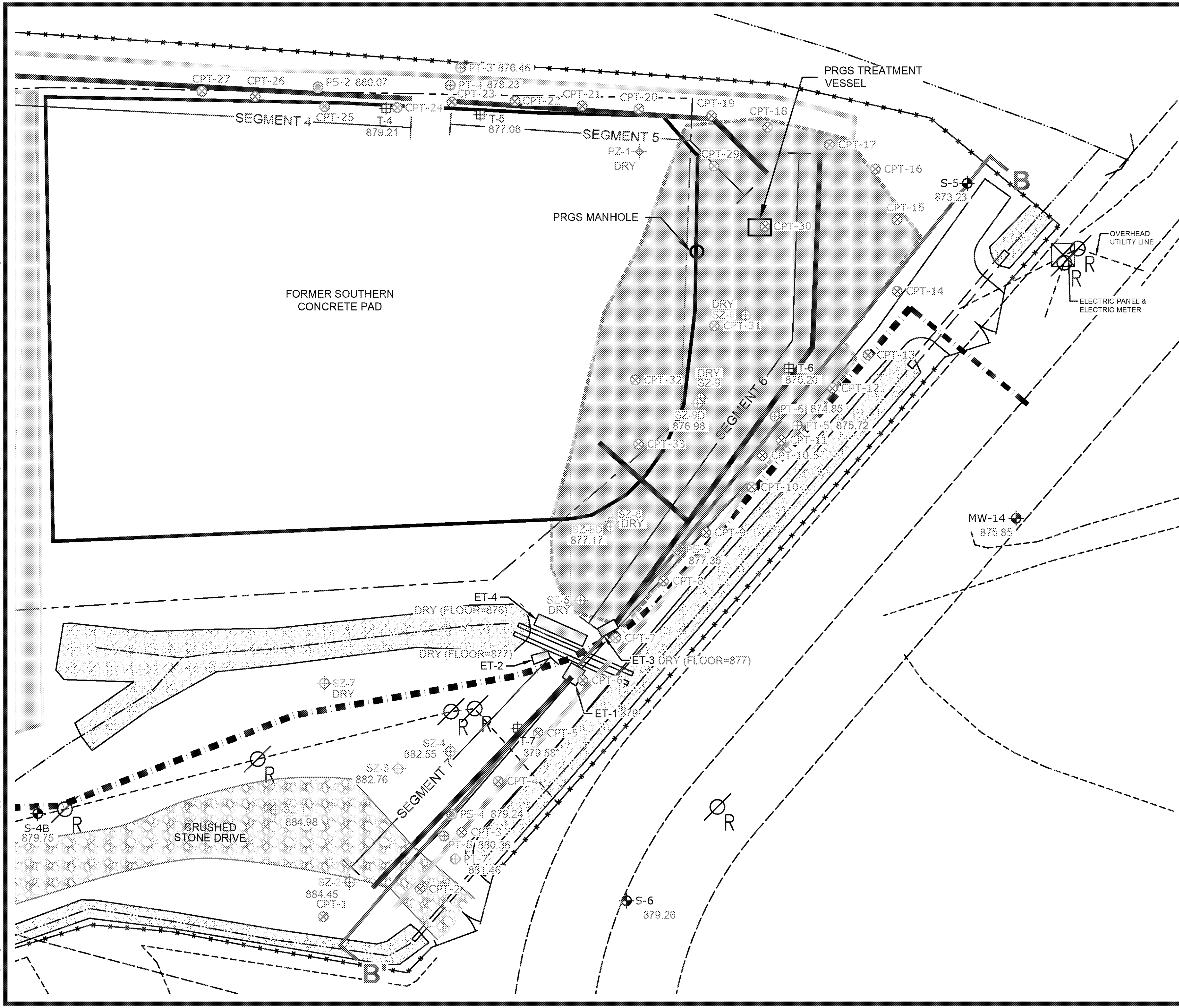

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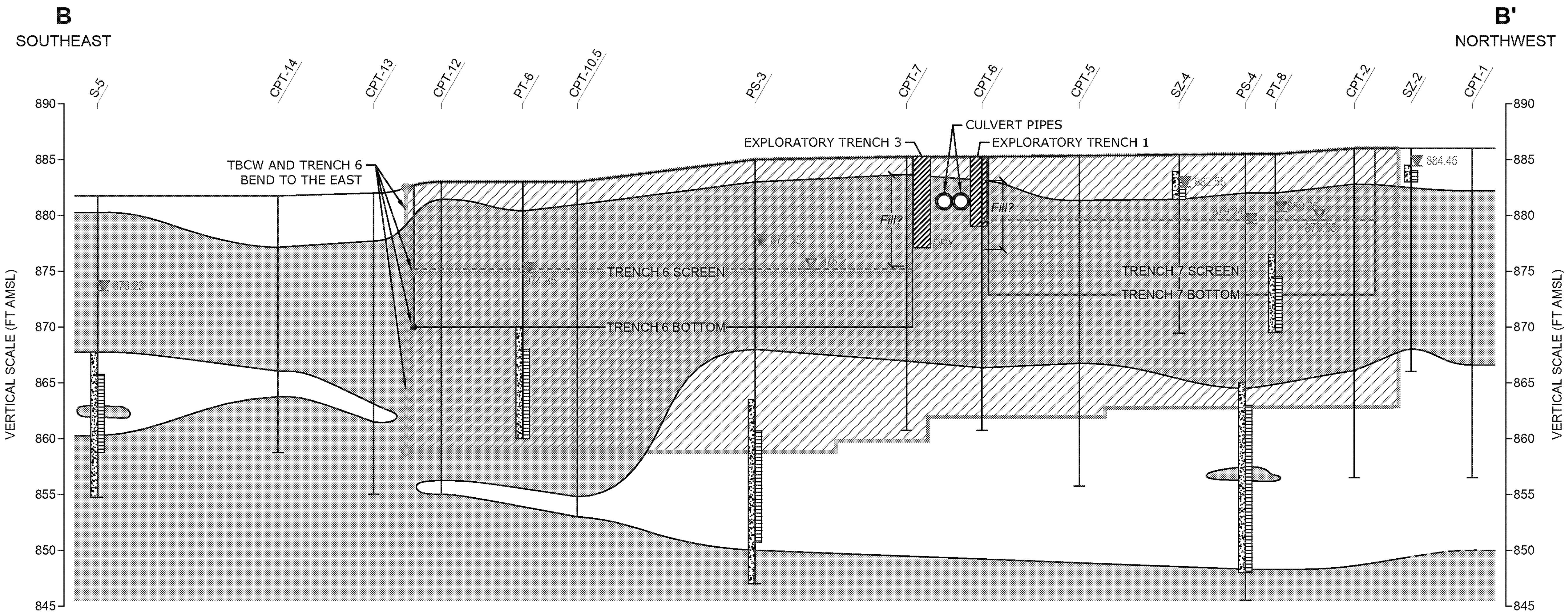
CROSS SECTION B-B' LOCATION MAP AND SUBSURFACE WATER ELEVATIONS OCTOBER 23, 2014

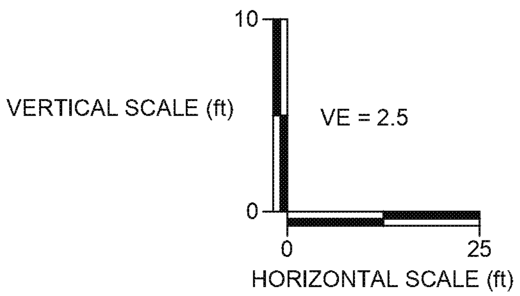
ENVIRO-CHEM SUPERFUND SITE
985 S. US HIGHWAY 421
ZIONSVILLE, INDIANA

RAMBOLL ENVIRON

FIGURE 1

DRAFTED BY: APR/CKL | DATE: 1/11/16 | 2131364F





LEGEND

- SCREEN INTERVAL
- SAND PACK INTERVAL
- THIN BARRIER CURTAIN WALL (TBCW)
- TRENCH ASVE SCREEN ELEVATION
- TRENCH BOTTOM ELEVATION
- PIEZOMETER WATER ELEVATION
- TRENCH WATER ELEVATION

LITHOLOGY

- SAND AND GRAVEL
- SILT AND CLAY

NOTES:

1. GROUND SURFACE ELEVATION DERIVED FROM THE AUGMENTED SVE SYSTEM DESIGN REPORT, ENVIRON, 2005.
2. TBCW ELEVATIONS DERIVED FROM THE SCHNEIDER CORPORATION SURVEY REPORT, JULY, 2006.
3. SUBSURFACE WATER ELEVATIONS MEASURED OCTOBER 23, 2014. WATER ELEVATION FOR TRENCH 7 COLLECTED ON OCT. 31, 2014.

SUBSURFACE WATER ELEVATIONS
OCTOBER 23,2014
CROSS SECTION B-B'
ENVIRO-CHEM SUPERFUND SITE
985 S. US HIGHWAY 421
ZIONSVILLE, INDIANA

RAMBOLL ENVIRON

FIGURE
2

DRAFTED BY: APR/CKL | DATE: 1/11/16 | 2131364F

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ATTACHMENT 2: Waterloo^{APS}

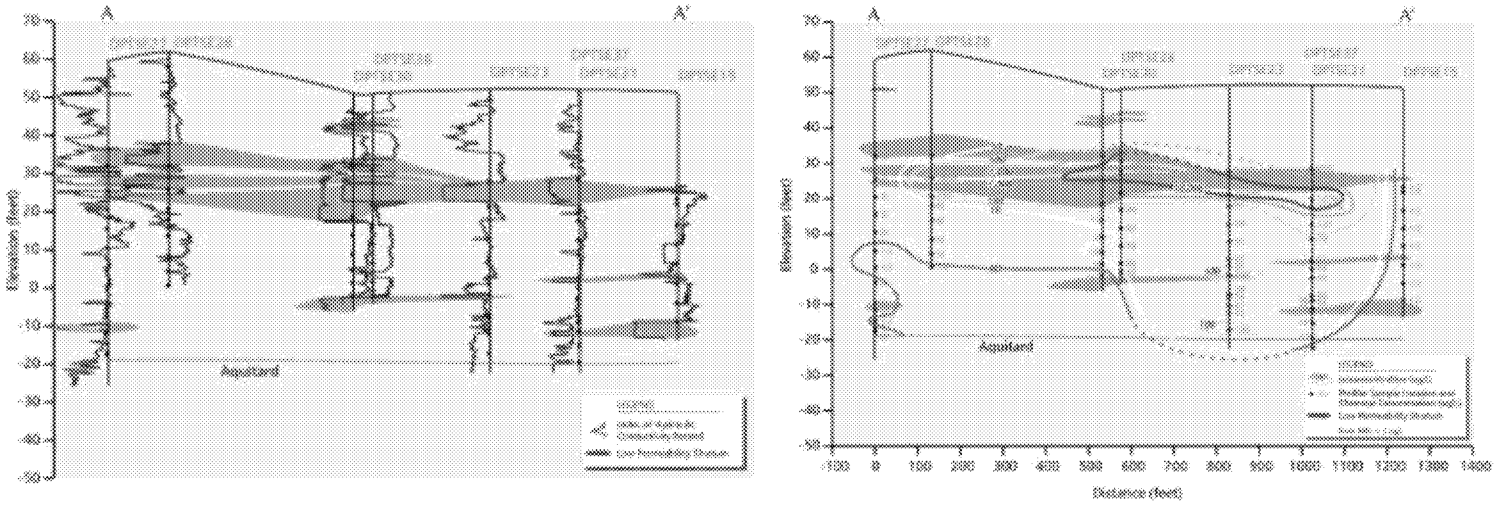
WATERLOO^{APS} TM

VERTICAL AQUIFER PROFILING WITH WATERLOO ADVANCED PROFILING SYSTEM

The Waterloo Advanced Profiling System (Waterloo^{APS}) is the next generation of the Waterloo Profiler that was originally introduced to investigation and remediation professionals in 1994.

Waterloo APS ™
ADVANCED PROFILING SYSTEM

Developed and tested extensively at the University of Waterloo, the Waterloo Profiler transferred High-Resolution Site Characterization (HRSC) capability from the groundwater research community to industry. Built around this tool, WaterlooAPS is a complete subsurface data collection platform, combining the same high-quality, discrete sampling capability with continuous, real-time hydrosratigraphic logging. This system has been utilized worldwide for the past 14 years in a broad array of environments. Using hybrid drive methods, the WaterlooAPS has achieved depths of 600 feet below ground surface. The profiler uses a KPRO system (hydraulic conductivity profiling), a tool that provides a real-time continuous Index of Hydraulic Conductivity (IK) to determine the stratigraphy and best depths for sample collection.



Real-time hydrostratigraphic profiling in the same push with discrete depth sampling, without withdrawing the tool between samples, allows for very efficient high-resolution groundwater contamination investigation. In this figure the Ik allowed the investigator to identify and sample sand lenses within a clay unit that serve as major contaminant transport pathways.

REAL-TIME HYDROSTRATIGRAPHIC LOGGING AND SAMPLING IN A SINGLE PUSH

The KRPO system incorporated into the Waterloo^{APS} is the original injection logging hydraulic profiling tool. As the tool advanced, clean water is injected into the formation while depth, pressure and flow rate are monitored. From these data, a real-time continuous log of the Index of Hydraulic Conductivity is calculated. It is not necessary to drive the tool once to log the hydrostratigraphy and again to sample – both are accomplished in a single push.

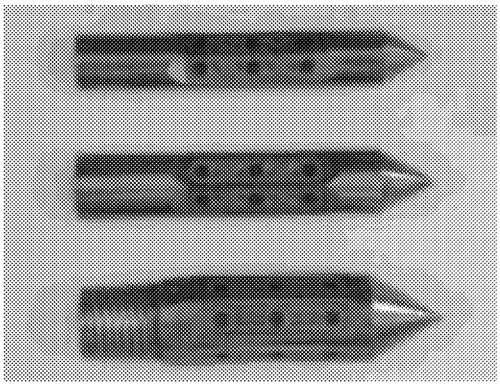
SAVING TIME AND MONEY

The integrated KRPO hydrostratigraphic profiling system saves time and money in three important ways:

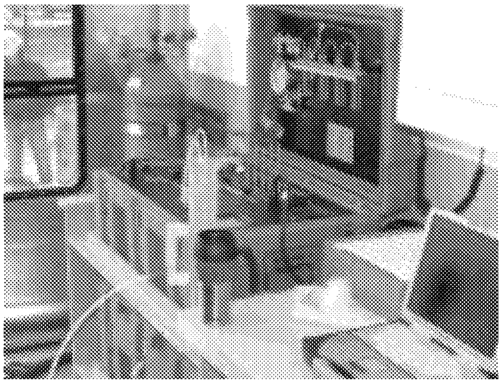
- KPRO helps us select depths at which to collect samples based on changes in stratigraphic as opposed to random or predetermined "blind" intervals. The I_k and sample collection are accomplished in a single push to obtain data more quickly and cost effectively.
- It enables a better understanding of the site's hydrostratigraphy for the creation of more accurate conceptual site models, and flow and transport models.
- It identifies impermeable zones so time is not water trying to collect water samples in suboptimal locations. Low permeability zones can, and should, be sampled high-resolution soil sampling techniques.

MULTIPLE MODELS FOR VARIOUS HYDOGEOLOGIC CONDITIONS

1. Waterloo^{APS} 224 – a 2.25-inch OD version of the most robust model, build to be used with the Geoprobe 8040 rigs for maximal depth penetration. The tip has more open area for higher sampling rates and reduced clogging. The 225 can be used with either a peristaltic pump or with the downhole nitrogen drive positive displacement pump.
2. Waterloo^{APS} 175 – the 1.75-inch OD version is the same diameter as the original Waterloo Profiler but utilizes more durable direct push rod and has the unique APS tip design.



One of these three profiling tip models is right for most conditions.



The KPRO system provides an integrated, high quality, high-resolution data collection system.

ATTACHMENT 3: Soil Gas Standard Operating Procedures

SUGGESTED OPERATING PROCEDURE
SOIL GAS PROBE INSTALLATION
Geosyntec Consultants, Inc.

1 INTRODUCTION

This suggested operating procedure (SOP) describes the design and methods for the installation of soil gas probes of sufficient quality to assess potential human health risks due to subsurface vapor intrusion to indoor air and subsequent inhalation exposures.

2 SOIL GAS PROBE DESIGN AND INSTALLATION

2.1 Compliance with Site Dig Permits and Utility Clearances

Site specific permits may be required prior to subsurface activities. Necessary permits will be secured in advance of any drilling activities. Underground utilities (water, sewer, electricity, gas, cable, telephone, etc.) will be reviewed prior to drilling.

2.2 Soil Coring via GeoProbe®

Soil core will be collected with a GeoProbe® direct push system (or equivalent). This method minimizes the disturbance to the geologic materials surrounding a soil gas probe subsequently installed in the core-hole. A 2-inch diameter core barrel will be used, since this provides sufficient core volume for field screening, geologic logging, and selected laboratory analyses (if required).

2.3 Geologic Logging

Soil cores will be photographed and inspected to record details of the color, texture, moisture, density, cohesion, plasticity, staining, and odor.

2.4 Soil Samples for Analysis of Physical Properties (if required)

After geologic logging of the soil core, soil samples will be collected for laboratory analysis of moisture content, grain-size distribution, porosity and bulk density by laboratory methods:

Soil Moisture Content: ASTM D2216
Grain Size: ASTM D422
Porosity: API RP40
Bulk density: API RP40

Samples will be selected to represent each distinct geologic layer. The number of samples to be collected will be determined by the geologist after inspection of the soil core and consideration of the degree of heterogeneity in the geologic materials.

2.5 Soil Gas Probe Installation

Each soil gas probe will consist of ¼-inch diameter Nylaflow® or Teflon® tubing connected with a compression fitting to a ¼-inch-diameter stainless steel sampling point. Probes will be installed inside the borehole and a sand filter pack will be placed in the annulus to a height of 6 inches above the top of the screen. Granular bentonite will be placed in two lifts of 3 inches above the filter pack and hydrated with a small amount of distilled water after each lift. A thick slurry of powdered bentonite and water will be added to seal the remainder of the borehole annulus to ground surface. The top of the probe will be fitted with a compression-fit brass or stainless steel ball valve to maintain an air-tight seal between installation and sampling. Permanent probes will be completed with a traffic rated flush mount protective casing.

3 DOCUMENTATION

Field documentation will include the following information:

- name and number of project;
- name of field personnel;
- date and time of sampling event;
- list of the primary activities performed;
- identification of probes drilled and installed;
- relevant information (weather, attendees, equipment problems, departures from standard procedures and the reasons and responses) observed throughout the day;
- field instrument information and calibration data (includes time and reading for each instrument calibration check; and
- volume of probe dead space volume for each soil gas probe.

SOIL GAS PROBE CONSTRUCTION

Geosyntec consultants

Probe ID ______________________ **Site Location** ______________________

Project Name ______________________ **Field Personnel** ______________________

Project Number ______________________ **Recorded By** ______________________

Permit Number ______________________ **Drilling Contractor** ______________________

Installation Date(s) ______________________ **Driller** ______________________

Drilling Method ______________________ ☐ **Temporary Soil Gas Probe**

Borehole Diameter ______________________ ☐ **Permanent Soil Gas Probe**

Materials Used

Pipe/Tubing :
Diameter ______________ cm/inches
Construction ______________
☐ Nylaflow Tubing
☐ Other ______________

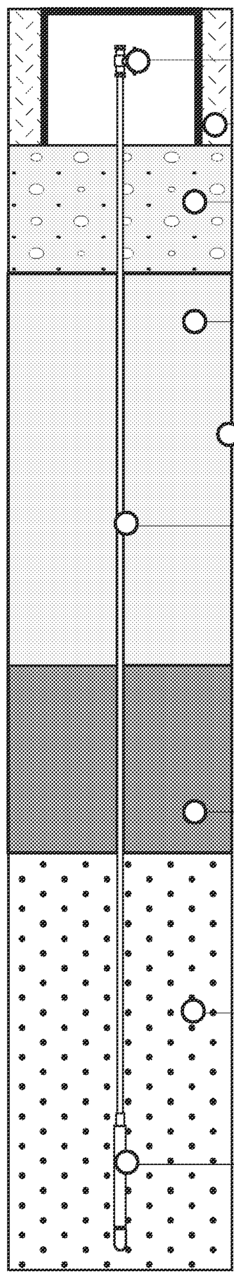
Soil Gas Implant :
Length ______________ cm/inches
Diameter ______________ cm/inches

Construction
☐ Stainless Steel
☐ Brass
☐ Polyethylene
☐ Other ______________

Surface Fitting:
☐ Ball valve with compression fittings
☐ Other ______________

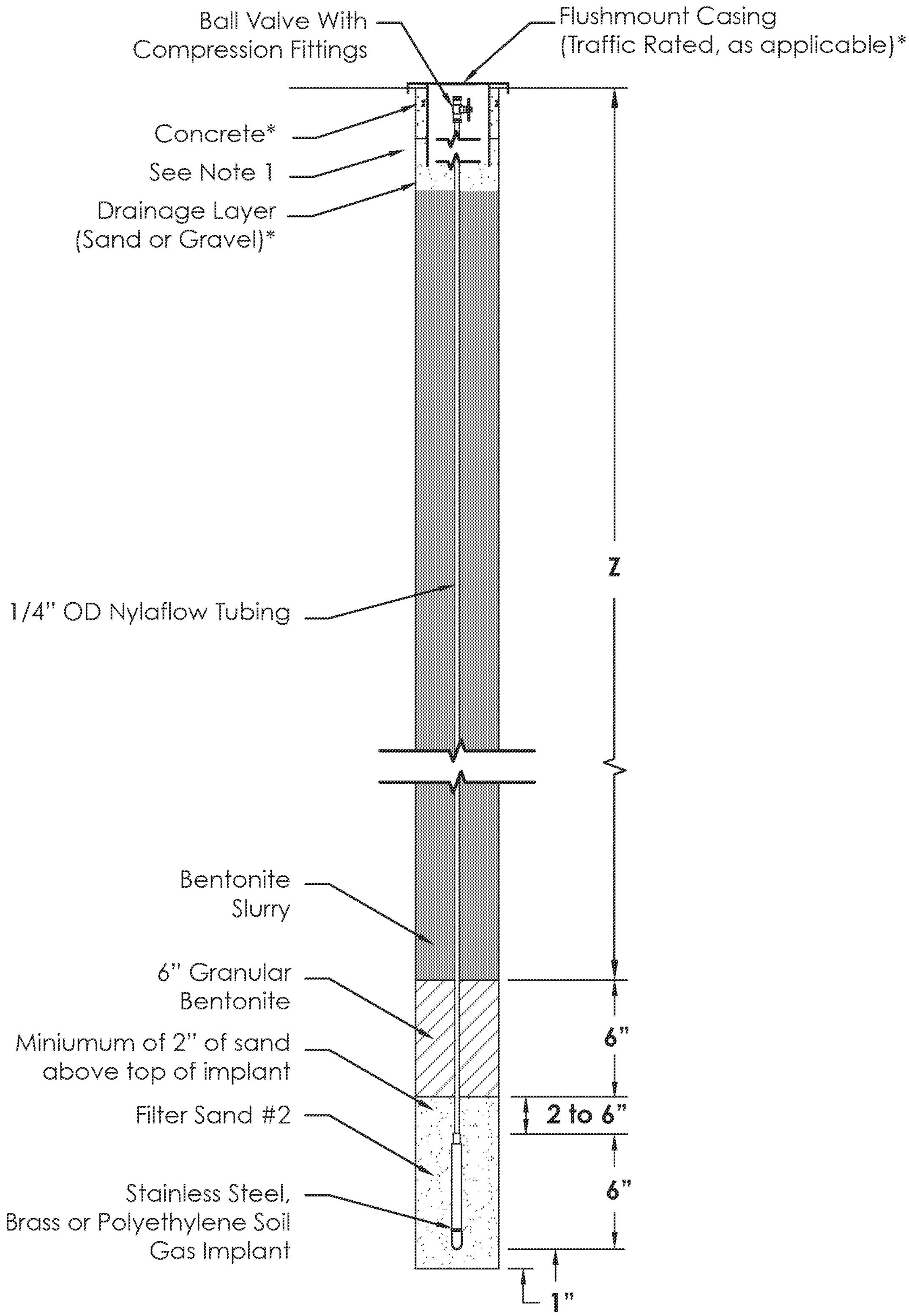
Protective Casing:
☐ Flush mount
☐ Above grade
Length ______________ cm/inches
Stickup ______________ cm/inches
Construction
☐ Cast Aluminum
☐ Cast Steel
☐ Other ______________

Casing Installation:
Depth ______________ cm/inches
Diameter ______________ cm/inches



** Depth Below Ground Surface*

Soil Gas Probe Construction 2016_TR0254.ai



Notes:

1. Nylaflow tubing can be up to 30 centimeters longer at surface in order to facilitate sampling. Tubing must be coiled up and stored in road box sampling events.

* - for permanent soil gas probes only

Soil Gas Probe Detail		
Geosyntec consultants		Figure 1
Guelph	December 2016	

SUGGESTED OPERATING PROCEDURE

PNEUMATIC TESTING

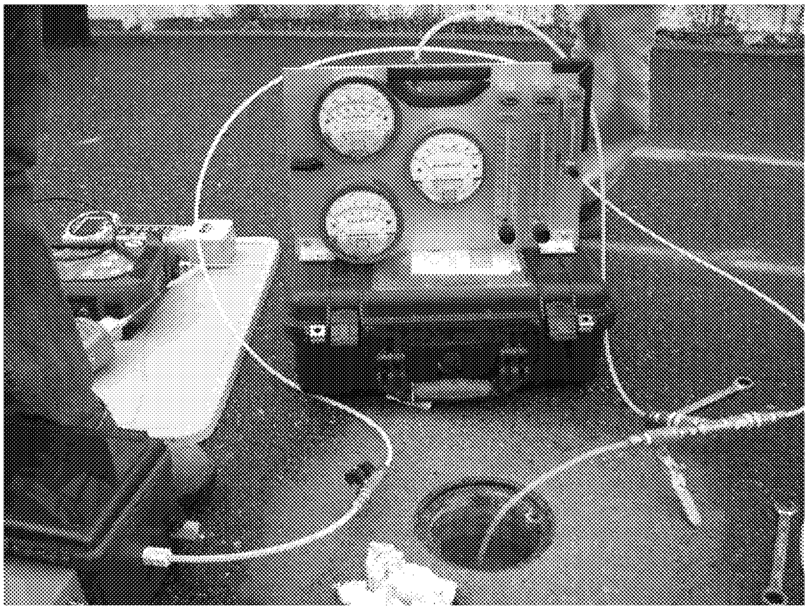
Geosyntec Consultants, Inc.

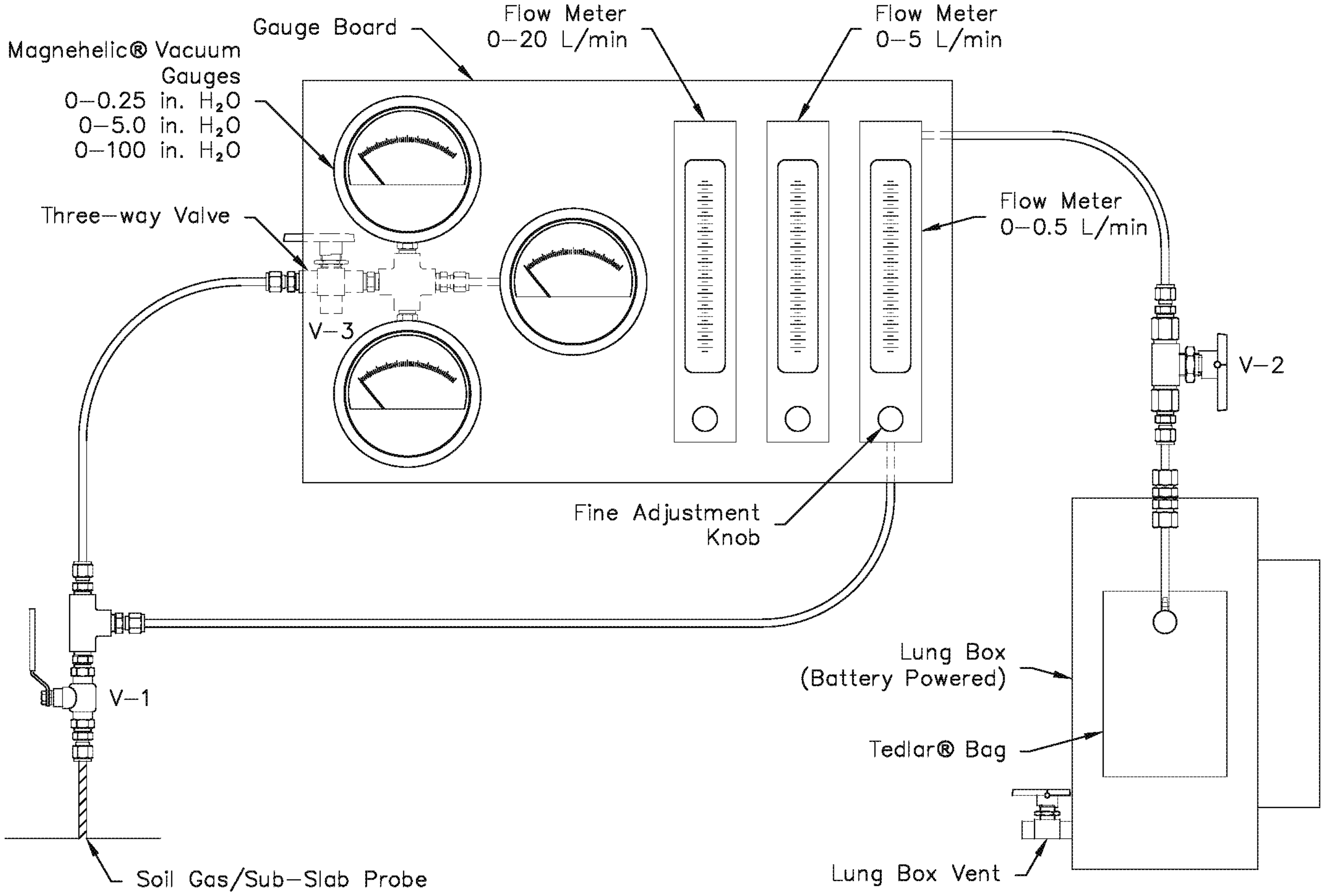
Last revision: August 2011

1 PNEUMATIC TESTING

Pneumatic testing is the procedure for measuring the flow and vacuum, which can be used to calculate the soil gas permeability of the surrounding geologic materials.

To measure the soil gas flow and corresponding vacuum, the equipment will be assembled as shown on Figure 1. The fine adjustment knob on the rotameter will be closed. Valves V-1 and V-2 will be opened as the lung box is turned on. The fine adjustment knob is then slowly opened until there is a measurable flow of 100 milliliters per minute (mL/min). The corresponding vacuum, as well as the flow rate, will be recorded. The rotameters must be vertical to accurately measure flow. Depending on the gas permeability of the subsurface materials, it may be necessary to switch to a higher scale vacuum gauge (0-5 in H_2O or 0-100 in H_2O) using the three-way valve (V-3). Both flow and vacuum should be clearly measurable within the scales of the vacuum gauge and rotameter. The flow rate will be increased to 200 mL/min and the vacuum observed will be recorded. This will be repeated at a flow rate of 500 mL/min. The flow and vacuum readings will stabilize almost instantaneously; therefore, the total volume of soil gas removed during the flow and vacuum test will be typically less than 1 L.





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Pneumatic Testing Assembly

Geosyntec consultants

Guelph	July 2009	Figure 1